Honors Chemistry
December 15, 2009

Chapter 6 Test
Honor Pledge: _____ (please initial)

1. Use the following equations and Hess's law to calculate the enthalpy change for the following reaction.

$2\ NO_2\ (g) + \frac{1}{2}\ O_2\ (g) \rightarrow N_2O_5\ (s) \qquad \Delta H = ?$

5

Given equations:

$N_2O_5\ (s) \rightarrow 2\ NO\ (g) + \frac{3}{2}\ O_2\ (g) \qquad \Delta H = 223.7\ kJ$ flip $\Delta H = -223.7$

$NO\ (g) + \frac{1}{2}\ O_2\ (g) \rightarrow NO_2\ (g) \qquad \Delta H = -57.1\ kJ$ flip x2 $\Delta H = 114.2$

$\Delta H = -109.5\ kJ$

2. A common space-heater fuel has a formula of $C_{12}H_{26}$.

1 a.) Write a balanced equation for the combustion of $C_{12}H_{26}$.

$2\ C_{12}H_{26} + 37\ O_2 \rightarrow 24\ CO_2 + 26\ H_2O$

b.) If the ΔH°_{rxn} for the equation above is -1.50×10^4 kJ, calculate the standard enthalpy of formation for the fuel, ΔH°_f. Other ΔH°_f values are found in the accompanying data table. Show work.

5 $-1.50 \times 10^4 = [24(-395.5) + 26(-241.8)] - 2X$

$X = -365.4\ kJ/mol$

4 c.) Calculate the heat produced by the combustion of 0.50 g of $C_{12}H_{26}$. Show work.

$0.50\ g\ C_{12}H_{26} \times \frac{1\ mol}{170.38\ g} \times \frac{-1.5 \times 10^4\ kJ}{2\ mol} = -22.1\ kJ$

$q = 75g\,(4.18)(2.8°C)$

$q = mC\Delta T = 877.8J$

3. A 22.0 g piece of metal is heated to 100.0°C and placed in 75.0 g H_2O at 25.0°C. If the final temperature of the metal and water is 27.8°C, what is the specific heat of the metal?

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a.) 0.038 J/g°C
b.) 0.16 J/g°C
c.) 0.55 J/g°C
d.) 5.0 J/g°C

$877.8 = 22g\,(x)\,(72.2°C)$

$x = \frac{877.8}{1588.4} = 0.55\,J/g°C$

4. For which reaction is ΔH°_{rxn} equal to ΔH°_f for $CuSO_4(s)$?

1

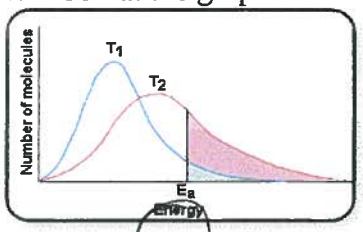
a.) $Cu^{+2}\,(aq) + SO_4^{-2}\,(aq) \rightarrow CuSO_4\,(s)$
b.) $CuO\,(s) + SO_3\,(g) \rightarrow CuSO_4\,(s)$
c.) $CuS\,(s) + 2\,O_2\,(g) \rightarrow CuSO_4\,(s)$
d.) $Cu\,(s) + S\,(s) + 2\,O_2\,(g) \rightarrow CuSO_4\,(s)$

$\Delta H = +$

5. When 1 mole of KBr (s) decomposes to its elements, 394 kJ of heat is absorbed. What is the sign of ΔH for the system?

1

6. Look at the graph.



Which line, T_1 or T_2, represents the sample at the lower temperature? How do you know?

2

lower KE

7. The thermochemical equation for the decomposition of $CaCO_3$ is given.

$CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g) \quad \Delta H = 178.3\ kJ$

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(a) What is the ΔH for the reaction, $CaO\,(s) + CO_2\,(g) \rightarrow CaCO_3\,(s)$? $-178.3\ kJ$

(b) What is the ΔH for the reaction, $3\,CaO\,(s) + 3\,CO_2\,(g) \rightarrow 3\,CaCO_3\,(s)$? $-534.9\ kJ$

8. Is it true to say that when the temperature of a sample of molecules is doubled that the kinetic energy of each molecule in the sample is also doubled? Explain.

2

No! Temp is a measure of the average KE of the molecules, some moving faster & some slower.

9. Liquid hydrogen peroxide releases oxygen gas on decomposition.

$$2\ H_2O_2\ (\ell) \rightarrow 2\ H_2O\ (\ell) + O_2\ (g) \quad \Delta H^\circ_{rxn} = -196.1\ kJ$$

Calculate the ΔH°_f for H_2O_2 (ℓ). Show work.

5

Hint: $\Delta H^\circ = \sum H^\circ_f \text{products} - \sum H^\circ_f \text{reactants}$

$$-196.1\ kJ = \left(2(-285.8) + 0\right) - 2X$$

$$+196.1 = +571.6 + 2X$$

$$2X = -375.5$$

$X = 187.8\ kJ/mol$

10. When a metal alloy at 93.0°C is added to water at 22.0°C, does heat transfer from the metal alloy to the water or from the water to the metal alloy? Explain using the definition of temperature.

Yes

Heat flows from object of higher temp to object with lower temp until thermal equilibrium is reached.

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11. A sample of 10.1 g of NH_4NO_3 was dissolved in 125 g of water in a calorimeter. The temperature changed from 24.5°C to 18.8°C. Calculate the ΔH in units of kJ per mole of NH_4NO_3. Show work. The specific heat of water is 4.18 J/g°C.

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$$q_{H_2O} = 125(4.18)5.7^\circ C = 2978.3\ J$$

$$10.1\ g\ NH_4NO_3 \times \frac{1\ mole}{80.06\ g}$$

$$\frac{2978.3}{1000} = \frac{2.98\ kJ}{0.126\ mole} \qquad = 0.126\ mole$$

$23.6\ kJ/mol$